RESEARCH ARTICLE

COMPARATIVE STUDY OF EFFECT OF CASING MATERIAL ON THE PRODUCTION OF MILKY MUSHROOM STRAINS, APK-2 AND CI-9

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Abstract: The study was undertaken to assess the effect of different casing ratio and thickness on yield parameters of both strains APK-2 and CI-9. Casing material consisting of Farm yard manure, Garden soil and Vermi Compost were tried with different ratio 3:2:1, 3:2:2 and 3:2:3. The casing ratio 3:2:1 resulted best for NOPF (11.67 and 12.67 days) and first harvesting (18.33 and 20.33 days) in strains APK-2 and CI-9 respectively. Maximum NOPF (58.67 and 60.33 per bag), NOFB (20.67 and 22.33 per bag) were showed in casing ratio 3:2:1 for both the strains APK-2 and CI-9. Maximum yield was harvested in casing ratio 3:2:3, 574.33 and 599.33 g/kg of dry substrate with 47.86 % and 49.94 % B.E., in strains APK-2 and CI-9, respectively. The casing thickness 1.25cm took least time to for pinhead formation (13.00 and 14.00 days) and for first harvesting (21.67 and 20.67 days), in strains APK-2 and CI-9, respectively. Also the casing thickness 1.25 resulted in maximum number of fruiting bodies harvested from (20.00 and 21.33) and maximum yield 619.67 and 636.33 g/kg of dry substrate with 51.63 % and 53.02 % B.E., from APK-2 and CI-9, respectively.

Keywords: Mushroom, Production, Crop, Laboratory

INTRODUCTION

The beautiful and delicate umbrella of mushrooms (the fungus 'flowers') must have attracted the attention of nature lovers. There are hundreds of identified species of fungi which, since time immemorial, have made a significant global contribution to human food and medicine. It is an exotic and nutritious source of vegetarian food.

A substrate is an important substance for growing mushrooms. Usually, a wide range of diverse cellulosic substrates are used for cultivating mushrooms (Amin et al,). During mushroom cultivation, compost colonized with mushroom mycelium is covered with a thick casing layer which is a nutritionally deficient medium to initiate the development of sporophores. Casing acts as a platform for initiation of uniform fructification and also provides anchorage and essential reserves for developing sporophores of mushrooms (Shandilya, 2002). Physical and chemical properties of casing like water holding capacity, porosity, bulk density, pH and electrical conductivity play very important role during mushroom production. In addition to physical and chemical parameters, microbiological parameters of the casing are also important for the proper fruiting of mushroom.

The physical, chemical and microbial properties of casing soil have been reported to play very important role in increasing yield and quality of mushroom (Lambert and Humfeld, 1939; Lambert, 1933 and Eger, 1961).According to the suitability and availability various kinds of casing materials are used for pin head initiation. Casing of cultivation beds was first done by Purkayastha *et al* during production of *C. indica*. Then alot of work has been done to study physical, chemical and microbial properties of casing soil to examine the effects in increasing yield and quality of mushrooms. Casing supplementations has also been done like addition of growth regulators, chemicals, organic supplements and this reported surprising results (Singh, 2012; Kumar *et al.* 2012).

In the present study the effect of different thickness and mixtures of casing material on productivity of different strains of *Calocybe indica* has been studied.

METHODS MATERIALS

The experiments were conducted in Mushroom Laboratory Department of Plant Pathology, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Utter Pradesh. Milky mushroom cultivation was done using cylindrical polythene bags filled with chopped wheat straw and spawning was followed @ 6 percent on wet weight basis. These bags were placed in the mushroom crop room at relative humidity of 80-85 per cent and temperature maintained 28±2˚C with full darkness.

Effect of different casing ratio on crop duration and productivity

In order to see the effect of casing mixtures on productivity of Milky mushroom cultivation of *Calocybe indica* strains namely APK-2 and CI-9 on different casing materials, such as Farm yard manure, Garden soil, Vermi compost in ratio of 3:2:2 ratio, 3:2:1 ratio and 3:2:3 ratio were tried. Observations were recorded as total yield (g/kg of dry substrate), days for pinhead formation (DFPF), days for first harvesting (DFFH), number of pinhead initiation (NOPI), number of fruiting bodies per bag (NOFB) and average weight of fruiting body (g/FB).

Effect of different casing thickness on cropping period and productivity

In order to see the effect of different casing thickness on productivity of Milky mushroom, cultivation of *Calocybe indica* strains namely APK-2 and CI-9

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casing, consisting of Farm Yard Manure + Sand + Garden Soil (1:1:1 w/w) each two years old and treated with formalin (4%) solution and kept covered for 48-72 hrs, was applied with a thickness of 1.25 cm, 1.5 cm, 1.75 cm and 2.0 cm was applied. Spawning and cultivation were same as given in cultivation technology. Observations were recorded as total yield (g/kg of dry substrate), days for pinhead formation (DFPF), days for first harvesting (DFFH), number of pinhead initiation (NOPI), number of fruiting bodies per bag (NOFB) and average weight of fruiting body (g/FB).

RESULTS AND DISCUSSION

Effect of different casing ratio on crop duration and productivity

The experiments were conducted to find out beneficial effect of the organic supplements in casing for pinhead formation, first harvesting, total yield and numbers of fruit bodies were recorded.

It has been revealed from the results mentioned in table-1 that among the tested casing ratio of Farm Yard Manure: Garden Soil: Vermi-compost, the ratio 3:2:1 showed best results for pinhead formation (11.67 and 12.67 days) followed by the casing ratio 3:2:2 (13.00 and 14.33 days) and first harvesting (18.33 and 20.33 days) followed by casing ratio 3:2:2 (20.33 and 22.33 days) in strains APK-2 and CI-9 respectively. Maximum days were taken for pinhead formation (15.00 and 16.33 days) and first harvesting (23.00 and 25.33 days) when all the casing materials were applied in the ratio 1:1:1 in strains APK-2 and CI-9 respectively. Maximum numbers of pinhead formation were showed in casing ratio 3:2:1 (58.67 and 60.33 per bag) followed by casing ratio 3:2:2 (56.67 and 58.33 per bag) in strains APK-2 and CI-9, respectively which was significantly superior to all the tested casing ratios while the minimum numbers of pinhead formation were found (15.00 and 16.33 days) in control (casing ratio 1:1:1) in strain APK-2 and CI-9, respectively. Maximum numbers of fruiting bodies were harvested also from casing ratio 3:2:1 (20.67 and 22.33 per bag) in were APK-2 and CI-9 strain followed by casing ratio (18.67 and 20.67 per bag) however, minimum numbers of fruiting bodies were harvested (15.67 and 18.33) from control (casing ratio 1:1:1). Maximum yield was harvested significantly well in casing ratio 3:2:2 from strains APK-2 and CI-9 (574.33 and 599.33 g/kg of dry substrate with 47.86 % and 49.94 % B.E.) followed by casing ratio 3:2:2 (560.00 and 579.00 g/kg of dry substrate with 46.67 and 48.25 % B.E.), respectively. However, maximum average weight per fruit body was recorded significantly well in casing ratio 1:1:1 (34.13 and 30.12 g) from strain APK-2 and CI-9, whereas next best treatment in order was casing ratio 3:2:1 (31.59 and 29.27 g), respectively.

Table 1. Effect of different casing ratio on crop duration and productivity of *Calocybe indica* using strain APK-2 and CI-9. (Cropping period: April- June)

S. No.	Casing ratio	DFPF	DFFH	NOPI	NOFB	Yield (g/kg dry substrate)	Average Weight (g/FB)	Biological efficiency (%)
1.	3:2:1 (APK-2)	11.67	18.33	58.67	17.33	545.67	31.59	45.47
2.	3:2:2 (APK-2)	13.00	20.33	56.67	18.67	560.00	30.10	46.67
3.	3:2:3 (APK-2)	14.00	21.67	54.33	20.67	574.33	27.89	47.86
4.	1:1:1 (APK-2)	15.00	23.00	51.33	15.67	531.33	34.13	44.27
5.	3:2:1 (CI-9)	12.67	20.33	60.33	19.33	563.00	29.27	46.91
6.	3:2:2 (CI-9)	14.33	22.33	58.33	20.67	579.00	28.14	48.25
7.	3:2:3 (CI-9)	15.33	23.67	55.33	22.33	599.33	26.95	49.94
8.	1:1:1 (CI-9)	16.33	25.33	53.00	18.33	549.00	30.12	45.75
CD at 5% Casing ratio		1.59	2.74	3.83	2.39	27.51	2.63	-
Strain		1.13	1.94	2.70	1.69	19.45	1.86	-
Casing ratio X strain		N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	-

Average of three replications, Ratio=Farm Yard Mannure: Garden Soil: Vermi Compost
DFPF= Days for pinhead formation, DFFH= Days for first harvesting,
NOPI= Number of pinhead initiation, NOFB= number of fruiting body

These results are in accordance with various workers like Shukla (2003) who studied different casing materials and obtained higher yield of milky mushroom from biogas slurry+soil (1:1) and cow dung manure+soil (1:1). Kumar *et al.* (2012) also reported that it is observed that FYM+GS+VC+SAND in 2:1:1:1 ratio show maximum yield in strain APK-2 while FYM+GS+VC+Sand in 1:2:1:1 ratio show maximum yield in strain CI-6. Maximum yield was recorded in casing thickness 1.25 cm/500 gm from strain APK-2 and CI-6.

Effect of different casing thickness on period and productivity

The experiment was conducted to see the effect of different casing thickness on pinhead formation, days for first harvesting, total yield and numbers of fruit bodies. Cultivation of *Calocybe indica* strains namely CI-9 and APK-2 on different thickness of casing was tried.

It is cleared from the results mentioned in Table-2 that among the tested casing thickness, the 1.25 cm/500 gm casing thickness took less period for pinhead formation (13.00 and 14.00 days) and for first harvesting (21.67 and for 20.67 days) followed by, the casing thickness of 1.5 cm/ 600gm (14.33 and 15.00 days) pinhead formation and (22.33 and 22.67 days) for first harvesting in strains APK-2 and CI-9, respectively. Maximum days were taken for pinhead formation (15.67 and 16.67 days) and first harvesting (25.67 and 24.33 days) when gave the thickness of casing (2.0 cm/800gm) in APK-2 and CI-9 strains, respectively. Maximum numbers of pinhead formation were showed in casing thickness 1.25 cm/500 gm (57.67 and 59.33 per bag) followed by 1.5 cm/600 gm (53.67 and 57.67 per bag) in strains APK-2 and CI-9, respectively which was significantly superior to all the tested casing thickness while the minimum number of pinhead initiation were found in casing thickness 2.00 cm/800gm (44.00 and 45.33) in strains APK-2 and CI-9, respectively. The maximum numbers of fruiting bodies were harvested from casing thickness 1.25 cm/500 gm (20.00 and 21.33 per bag) in APK-2 and CI-9 strain, respectively followed by, (19.00 and 20.33) in casing thickness 1.50 cm/600 gm in strains APK-2 and CI-9, respectively. Whereas, maximum yield was recorded significantly well in casing thickness 1.25 cm/500 gm from strains APK-2 and CI-9 (619.67 and 636.33 g/kg of dry substrate with 51.63 % and 53.02 % B.E.), respectively followed by (585.00 and 612.22 g/kg of dry substrate with 48.75 % and 51.02 % B.E.) in casing thickness 1.5 cm/600 gm from strains APK-2 and CI-9, respectively. However, maximum average weight per fruiting body was recorded significantly well with 2.0 cm/ 800 gm casing thickness in APK-2 (35.75 g) and from strain CI-9 (33.61 g).

Shukla *et al.* (2007) indicated that casing soil should be prepared in ratios of SFR- (soil FYM ratio) 1:1 to 3:2 and SCR (soil –spent compost ratio)- 1:1 to 2:3 for uniform pinhead initiation with 2.0 cm thick layer at right time and max. yield of mushroom. Pani (2012) observed that 2 cm thick casing layer was ideal for quickest primordial initiation, higher sporophore number and maximum yield. Thickness beyond 2 cm gradually decreased the mushroom yield and delayed the fruiting. Casing at the time of spawning was best in terms of quickest fructification (28 days), higher sporophore number (6) and maximum yield (74.6 % BE). Kumar *et al.* (2012) also reported that Maximum yield was recorded in casing thickness 1.25 cm/500 gm from strain APK-2 and CI-6.

Table 2. Effect of different casing thickness (cm) on cropping period and yield of *Calocybe indica* using strain APK-2 and CI-9. (Cropping period: April- June)

S. No.	Casing thickness (cm/gm)	DFPF	DFFH	NOPI	NOFB	Yield (g/kg dry substrate)	Average Weight (g/FB)	Biological efficiency (%)
1.	1.25 cm/500 gm (APK-2)	13.00	21.67	57.67	20.00	619.67	31.23	51.63
2.	1.5 cm/600gm (APK-2)	14.33	22.33	53.67	19.00	585.00	30.82	48.75
3.	1.75cm/700 gm (APK-2)	14.67	24.00	48.67	17.67	561.33	31.88	46.77
4.	2.0 cm/800gm (APK-2)	15.67	25.67	44.00	15.33	546.67	35.75	45.55
5.	1.25 cm/500 gm (CI-9)	14.00	20.67	59.33	21.33	636.33	29.83	53.02
6.	1.5 cm/600gm (CI-9)	15.00	21.67	57.67	20.33	612.33	30.18	51.02
7.	1.75cm/700 gm (CI-9)	15.67	23.00	53.33	19.00	594.33	31.32	49.52
8.	2.0 cm/800gm (CI-9)	16.67	24.33	45.33	17.33	577.33	33.61	48.11

CD at 5% Casing thickness	1.27	2.17	2.04	1.91	17.31	2.57	-
Strain	0.90	1.54	1.44	1.35	12.24	N.S.	-
Casing thickness X strain	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	-

Average of three replications, Casing Ratio=Farm Yard Mannure: Sand: Garden Soil
DFPF= Days for pinhead formation, DFFH= Days for first harvesting,
NOPI= Number of pinhead initiation, NOFB= number of fruiting body

CONCLUSION

The crop room experimentation revealed interesting results which explain that in different casing ratio of Farm Yard Manure: Garden Soil: Vermi-compost the ratio number of 3:2:3 produce significant results in terms of yield and biological efficiency. The experiment regarding casing thickness the casing thickness of 1.25 cm have showed results significantly well results in terms of minimum period for pinhead initiation, maximum number of pinhead initiation, maximum number of fruiting bodies, Yield and biological efficiency,

REFERENCES

Amin, R., Khair, A., Alam, N. and Lee, T.S. (2010). Effect of Different Substrates and Casing Materials on the Growth and Yield of *Calocybe indica*. *Mycobiology, **38** : 97-101.*

Eger, G. (1961). Under suchungen uber die funkion der Deck scichl bei der fruch korper bilding des kulturchampignons, *Psalliota bisporus* Lge. *Archive Fur Microbiol.,* **39**:313-314.

Kumar, R. Singh, G. Mishra, P. and Singh, R. (2012). Effect of different organic supplements and casing mixtures on yield of two strains of milky mushroom (*Calocybe indica*). *Indian phytopathology*. **65**(4): 399-403.

Lambert, E. B. and Humfeld, H. (1939). Mushroom casing soil in relation to yield. *U. S. Department of Agriculture, Circular No.*509. Washington, DC. pp.11.

Lambert, E.B. (1933). Effect of excess of carbon dioxide on growing mushrooms. *J. Agric. Res.*, **47**: 509-608.

Pani, B.K. (2012). Sporophore production of milky mushroom (*Calocybe indica*) as influenced by depth and time of casing. *International Journal of Advanced Biological Research*. **2**(1):168-170.

Shukla, C.S. (2003). Role of agronomical and biochemical parameters on growth and yield of *Calocybe indica* (P&C), Ph. D. thesis, IGAU, Raipur, pp.168.

Shukla, P.K. (2007). Effect of casing soil thickness on crop duration and yield of milky mushroom (*Calocybe indica* P&C). *Indian Phytopath.*, **60**(4):537-539.

Singh, V.P. (2012). Studies on spawn qualities and management of diseases of Milky mushroom (*Calocybe indica*). Ph. D. thesis, Department of Plant Pathology, SVPUA&T, Meerut.

T.R. Shandilya (2002). "*Indian Mushroom Conference*", TNAU, Coimbatore.